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1/77

1. Your reference	1999/II
2. Patent application number *(The Patent Office will fill in this part)*	0211374.4
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	Valquest Limited Oak Ashes Barn Bowes Hill Rowlands Castle Hampshire PO9 6BS GB
Patents ADP number *(if you know it)*	8037780001
If the applicant is a corporate body, give the country/state of its incorporation	GB
4. Title of the invention	Flow Mixer Shuttle
5. Name of your agent *(if you have one)*	NIGEL BROOKS CPA
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	HILL HAMPTON EAST MEON PETERSFIELD HAMPSHIRE GU32 1QN
Patents ADP number *(if you know it)*	463001

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
GB	na NA	NA NA

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a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
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Description	8
Claim(s)	0
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Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Date 17/05/02

12. Name and daytime telephone number of person to contact in the United Kingdom NIGEL BROOKS CPA (01730) 823647

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FLOW MIXER SHUTTLE

The present invention relates to a shuttle for a flow mixer and a mixer for two liquid flows at different temperatures, particularly though not exclusively for thermostatic mixing of water in a shower.

It is known to employ a thermostatic capsule to move a shuttle to open or close small gaps on either side of the shuttle. It is convenient for this shuttle to be circular with the gaps being annular, but this gives rise to other problems.

Conventionally the thermostatic capsule has:

- a circularly cylindrical, copper sheath containing thermostatic wax,
- a location flange at the inner end of the copper sheath,
- a spigot extending from the location flange oppositely from the sheath and
- a push rod extending from the spigot by an amount varying in accordance with the ambient temperature at the copper sheath.

The inlet to the annular gaps is conveniently radially inwards. Normally, the cold water flows in upstream of the hot water, whereby as the combined flow is turned to flow axially along the copper sheath of the thermostatic capsule, the cold water tends to flow closer to the capsule than the hot water. At least this is the situation close to the flange of the capsule which is its most sensitive part. Further downstream, the flow mixes better, so that the tail end of the capsule experiences a more representative temperature of the actual mixed what flow. Should the normal situation be reversed and hot water flow in upstream of the cold water, the same problem of the capsule not experiencing mixed water temperature at its flange end of the copper sheath will obtain.

The object of the invention is to provide an improved shuttle for a flow mixer, in which the hot and cold flows are mixed further upstream with respect to their impingement on the thermostatic capsule, whereby the capsule is shielded from un-diluted cold water flow and experiences a temperature more representative of the final mixed flow and its sensitivity in controlling water temperature is improved.

According to the invention there is provided a shuttle for a flow mixer having a thermostatic capsule, the shuttle comprising:

- a first annular rim for controlling flow of hot water;
- a second annular rim for controlling flow of cold water;
- a hub connected with the rims;
- a seat on the hub for supporting the thermostatic capsule at its flange with its sheath extending downstream of water flow past it and its push rod arranged for axial movement of the capsule to control the position of the shuttle; and
- a flow directing sleeve carried on the shuttle and extending at least partially about and at least substantially parallel to the sheath for directing mixed flow to the flange end of the sheath.

In use, the flow directing sleeve will co-operate with features of the mixer to assist in direction of the flow.

In the preferred embodiment, the sleeve is imperforate directing the flow along its length, a complementary sleeve being provided in the mixer for directing the flow back inside the shuttle sleeve to the flange region of the sheath and thence along the sheath.

According to the invention there is also provided a flow mixer comprising:

- a shuttle of the invention;
- a thermostatic capsule for controlling the position of the shuttle in accordance with ambient flow temperature;
- means for locating the flange of the capsule in the seat of the shuttle;
- a shuttle return spring for urging the shuttle and capsule combination to return from expansion movement caused by extension of the push rod with respect to the spigot;
- a shuttle barrel, in which the shuttle is slidably mounted, the barrel having:
    - a land co-operating with the shuttle to direct hot flow to the hot flow annular rim of the shuttle and cold flow to the cold flow annular rim of the shuttle and

- complementary hot and cold flow annular rims for controlling the hot and cold flows in co-operation with the shuttle's rims; and
- at least one flow direction feature for co-operating with the sleeve of the shuttle to direct the flow to the thermostatic capsule to the flange region of its sleeve.

In one embodiment, the flow direction feature is a complementary sleeve directing the flow which has passed along the outside of the shuttle sleeve back inside it to the flange region of the sheath and thence along the sheath.

Preferably the capsule flange locating means includes an over-travel spring acting between the shuttle and the spigot of the capsule, with a force greater than that of the return spring, for accommodating sudden changes in flow conditions causing the shuttle to be stopped by abutment against either of the annular flow rims.

According to a third aspect of the invention there is provided a single control flow mixer, the flow mixer comprising:

- a shuttle of the invention;
- a thermostatic capsule for controlling the position of the shuttle in accordance with ambient flow temperature;
- means for locating the flange of the capsule in the seat of the shuttle;
- a shuttle return spring for urging the shuttle and capsule combination to return from expansion movement caused by extension of the push rod with respect to the spigot;
- a shuttle barrel, in which the shuttle is slidably mounted, the barrel having:
    - a flow division member co-operating with the shuttle to direct hot flow to the hot flow annular rim of the shuttle and cold flow to the cold flow annular rim of the shuttle and
    - complementary hot and cold flow annular rims for controlling the hot and cold flows in co-operation with the shuttle's rims;
- a complementary sleeve directing the flow which has passed along the outside of the shuttle sleeve back inside it to the flange region of the sheath and thence along the sheath;

- a shut-off seal arranged between the flange of the thermostatic capsule and the complementary seal; and
- control means for both moving an abutment for the push rod of the capsule to adjust the thermostatically controlled flow from the mixer and for moving the abutment further to close the shut-off seal and stop the flow.

Preferably the control means is a rotary to linear converter, conveniently a screw thread, including a lever or knob movable through a first part of its travel from its closed position to open the shut-off seal and a second part of its travel to thermostatically control the flow through the mixer.

Again, the capsule flange locating means preferably includes an over-travel spring acting between the shuttle and the spigot of the capsule, with a force greater than that of the return spring, for accommodating sudden changes in flow conditions causing the shuttle to be stopped by abutment against either of the annular flow rims.

In the preferred embodiment, the over-travel spring is compressed by the control means, when the shut-off seal is closed, and the over-travel spring is released to its over-travel functional length when the control means is positioned for thermostatic control.

To help understanding of the invention, two specific embodiments thereof will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional side view of a conventional flow mixer showing the shuttle;

Figure 2 is a similar view of a mixer improved in accordance with the invention; and

Figure 3 is another similar view of a third mixer according to the invention.

Referring first to Figure 1, a conventional shuttle 1 and barrel 2 arrangement is shown, the shuttle being slidable in the barrel under control a shuttle spring 3 and an adjustable temperature control abutment 4 against which the push rod 5 of a

thermostatic capsule 6 abuts. The barrel has a land 7 with which the periphery 8, carrying an O-ring 9, of the shuttle sealingly co-operates.

The shuttle has first and second annular rims 11,12 for co-operating with complementary rims 13,14 on either side of the land for controlling flow of cold and hot water into the barrel. Arrangements for leading water to the barrel and from the barrel and for the adjustable abutment 4 will be within the abilities of the man skilled in the art and will not be described here.

In this conventional design of Figure 1, the cold water enters the barrel between the upper rims 11,13 and passes through apertures 15 in the shuttle. It flows close to the thermostatic capsule 6, which is supported at its flange 16 on a seat 17 in a hub 18 central on the shuttle. The hot water flows between the lower rims 12,14. The combined flow then turns along the sheath 19 of the capsule, in a comparatively wide bore 20 in the barrel. The hot water enters the barrel outwardly of where the cold water passes through the shuttle. Thus the two temperature flows C, H tend to remain separate, at least until they reach the tail end of the capsule. It is believed that the most sensitive region of the sheath, i.e. at the flange experiences mostly cold water. The capsule is therefore believed not to be as sensitive as it might be to temperature control adjustments.

The capsule is retained seated against the shuttle by an over-travel spring 21, acting between a nut 22 threadedly connected to a spigot 23 of the capsule and the cold side 24 of the shuttle. In the event of a sudden flow of hot water reaching the capsule, the latter may expand more than can be accommodated by closure of the gap between the lower rims. In this case, the over-travel spring is compressed and the flange of the capsule temporarily lifts out of the seat 17.

Turning now to Figure 2, the shuttle 101 according to the invention shown there has a sleeve 131 extending from the hub 118 of the shuttle inwards of the cold water apertures 115. Thus the cold flow C is directed along the outside of the sleeve, as indeed is the hot flow H. However they are in a comparatively narrow annular passage 132. Inwards of the sleeve 131, a second sleeve 133 extends up from a low region of the barrel. The combined flows are directed around the distal end 134 of the

sleeve 131 and back within it in a second narrow annular passage 135. In these two passages, which are comparatively long, the hot and cold flows become mixed. This mixed flow passes the distal end 136 of the inner sleeve and impinges on the thermostatic capsule at its most sensitive region, namely the flange end of the sheath. Thus the shuttle is rendered more sensitive to changes in temperature of the incoming water flow, as for instance when the hot water first reaches the mixer.

Turning on to Figure 3, the mixer there shown includes further features beyond those of Figure 2. Its shuttle 201 is slidingly accommodated in a two piece barrel 2021,2022. A hot and cold division member 207, with an O-ring 209, is integrally moulded with the upper barrel piece 2021 leaving cold water flow passages 2071. A secondary O-ring 2091 seals the division member 207 to the lower barrel piece 2022. An annular member 2072, providing hot water flow passages 2073 and abutting on the lower barrel part 2022, captivates the O-ring 209. The latter seals on the periphery 208 of the shuttle 201. The periphery has annular rims 211,212 and the barrel pieces have respective annular rims 213,214, the latter being an elastomeric seat. These define adjustable inlets for cold water C and hot water H. A central outlet H&C is provided in the barrel part 2022.

The shuttle has an inner sleeve 231 connected by webs 2312 to the periphery 208, defining apertures 215 allowing cold water to reach the outlet. It follows a serpentine course S around the lower end 234 of the sleeve 231 and over the upper end 236 of an inner sleeve 233, mixing en route with hot water, with the result that the mixed temperature flow impinges on the sheath 219 of a thermostatic capsule 206 close to its flange 216. The shuttle is urged upwards by a working spring 203 acting between the lower barrel part 2022 and legs 2341 extending down from the shuttle sleeve 231. In its features just described, the flow mixer of Figure 3 is generally similar to that of Figure 2 (though different in detail). The main improvements over Figure 2 will now be described.

The upper barrel part 2021 has a hollow spigot 251, with a threaded control member 252 sealed in the spigot via O-ring seals 253. The control member has a splined end 2521 for its actuation by a handle (not shown). An abutment member 254 threadedly receives in a threaded bore 2541 the aperture a threaded portion 2521 of

the control member 252. The member 254 has splines 2542 engaging complementary splines 2511 in the upper barrel part 2021. The spigot 252 has a step 2512 and the control member has an integral collar 2523 abutting the step, whereby turning of the control member threadedly advances or returns the abutment member 254.

A recess 255 in the bottom of the abutment member abuts the push rod 205 of the capsule, at least when the capsule is experiencing warm or hot water and the push rod is extended from its cold position with respect to the rest of the capsule. The rod extends out of an internally threaded socket 256 having a shoulder 257 for an over-travel spring 258. The socket is screwed onto a threaded spigot 223 of the capsule. When the capsule is cold and the push rod is able to pushed, by the spring 203, back into the spigot 223 and the socket 256, a rim 2551 of the abutment member abuts the shoulder 257 of the socket. The shuttle has an apertured, central disc 259, which forms the seat for the capsule. The latter is urged into the seat by the spring 258, which it engages in use via a flange 261 at the root of its spigot 223. On the underside of the flange, the capsule carries an elastomeric sealing disc 262.

In the state shown in Figure 3, the temperature of the combined flow H&C is thermostatically controlled. If, for instance, more cold water enters, perhaps by increasing cold water pressure, the capsule shrinks, allowing the shuttle to lift under the action of the return spring 203 and more hot water to enter. If the temperature is to be adjusted by rotation of the control member 252, to advance or return the abutment member 254, advance will reduce the gap between the shuttle rim 212 and the barrel rim 214 and lower the temperature by reducing the flow of hot water and return will have the opposite effect in reducing the gap between the shuttle rim 211 and the barrel rim 213 reducing the flow of hot water.

Further advance of the abutment member will close the shuttle against the seal 214 allowing cold water only to flow. The push rod will be driven home and the abutment member will abut the collar 257. Further advance still of the abutment member will not move the shuttle, which is stopped by the sealed 214. However, the capsule itself will be moved forwards with respect to the shuttle, the spring 258, which conventionally performs only an over-travel function, compressing between the central disc 259 of the shuttle and the collar 257. This movement will end with the

sealing disc 262 on the capsule sealing against the end 236 of inner sleeve 233. The result is complete closure of the mixer. In this closure closes both the hot water at the seal 214 and the cold water at the seal 262. Thus not only is no flow possible from the outlet H & C, but also no flow is possible from one of the inlets H, C to the other.

It will be appreciated that, as is conventional, the working spring 203 is weaker than the over-travel spring 285.screwing in will fully close the hot inlet and lift the capsule from its seat. The sealing disc 262 will come to seal against the upper end 236 of the inner sleeve 233 and in doing so will close the flow from the mixer.

For this sealing, the over-travel spring is compressed by the socket 256 and its collar 257, which are drawn down by the capsule being compressed downwards.

For use of the shower, or other appliance to which the mixer is attached, the control member is turned back to open the outlet H&C and continued to be opened until the shuttle position for the desired temperature of water flow is achieved.

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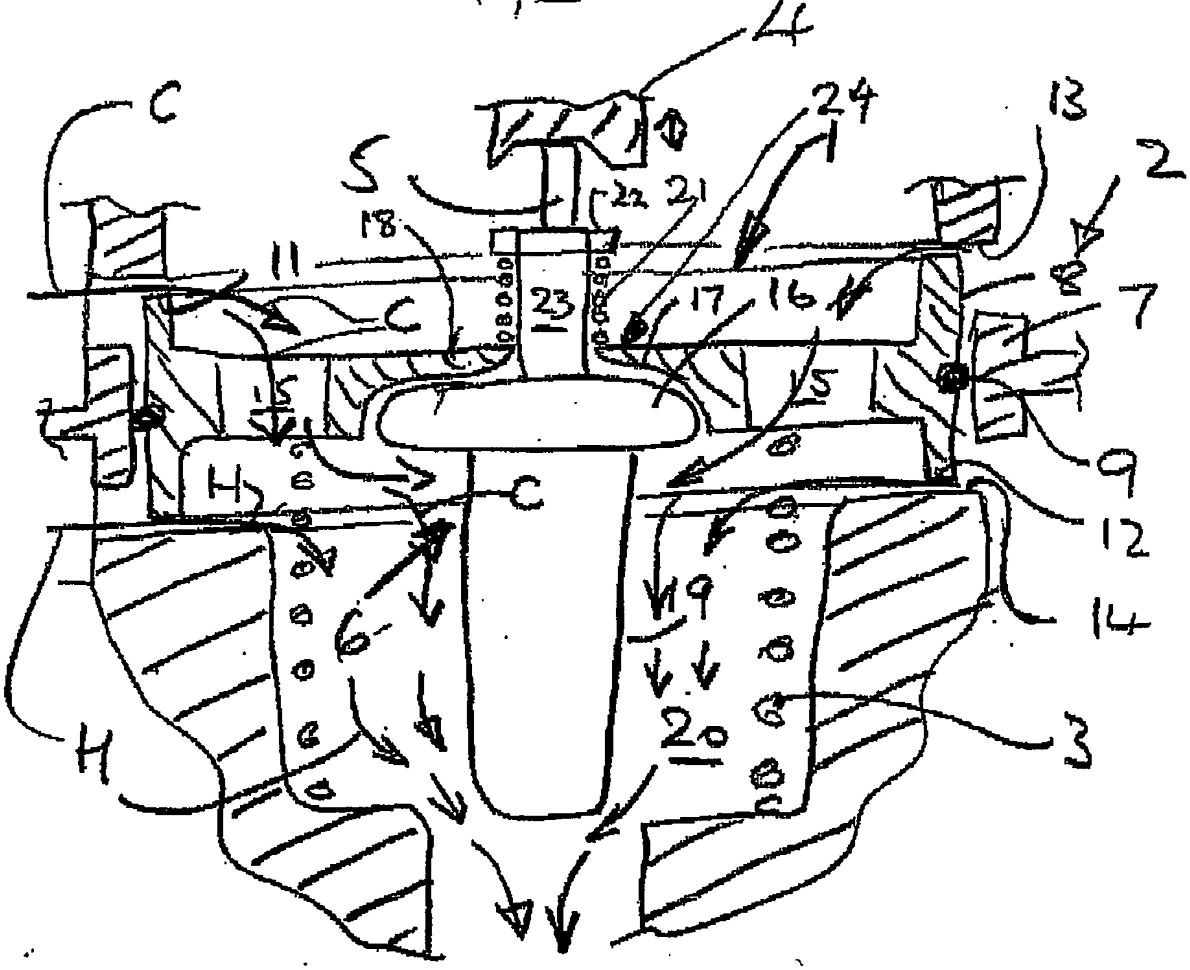

FIGURE 1

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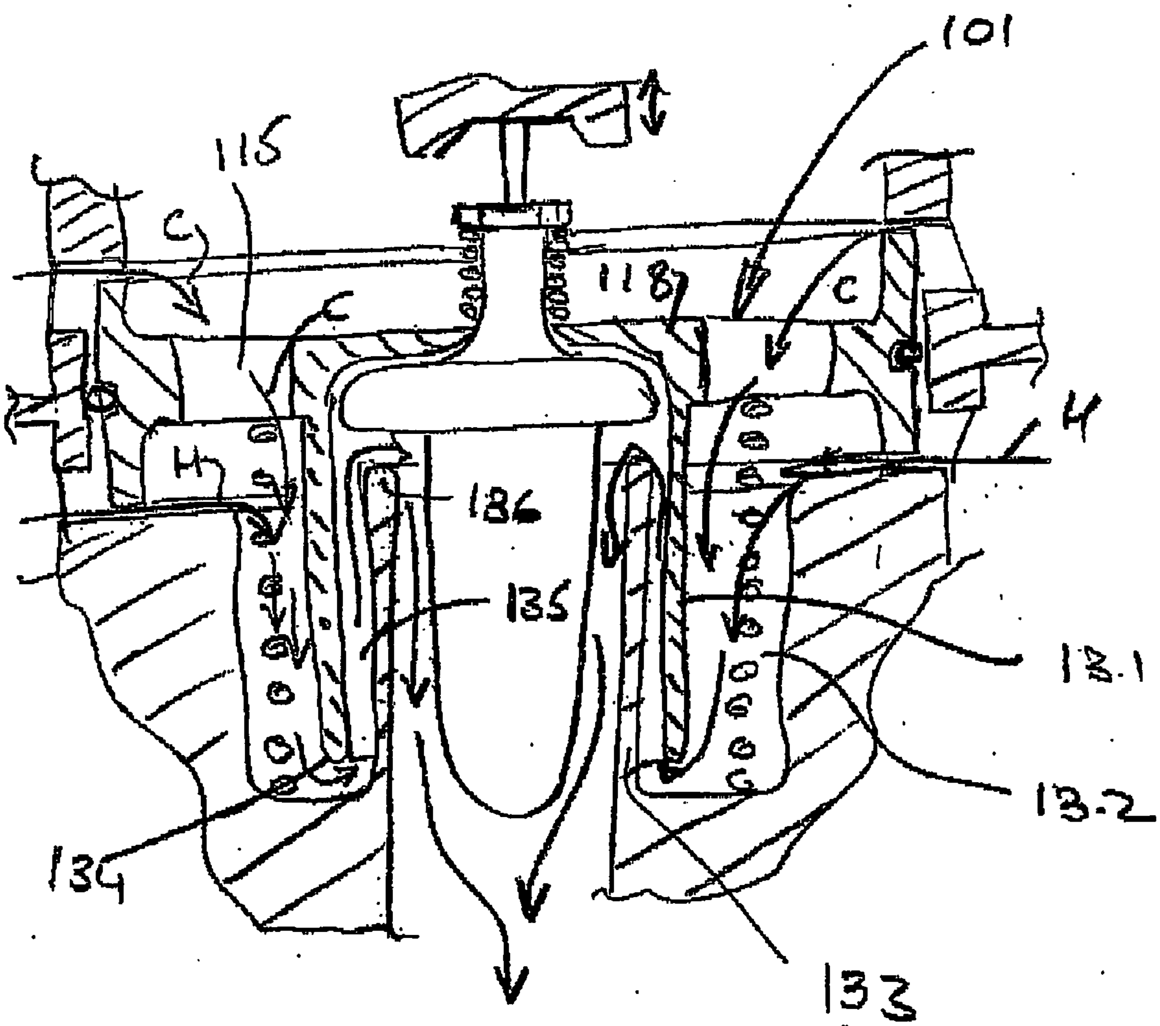

FIGURE 2

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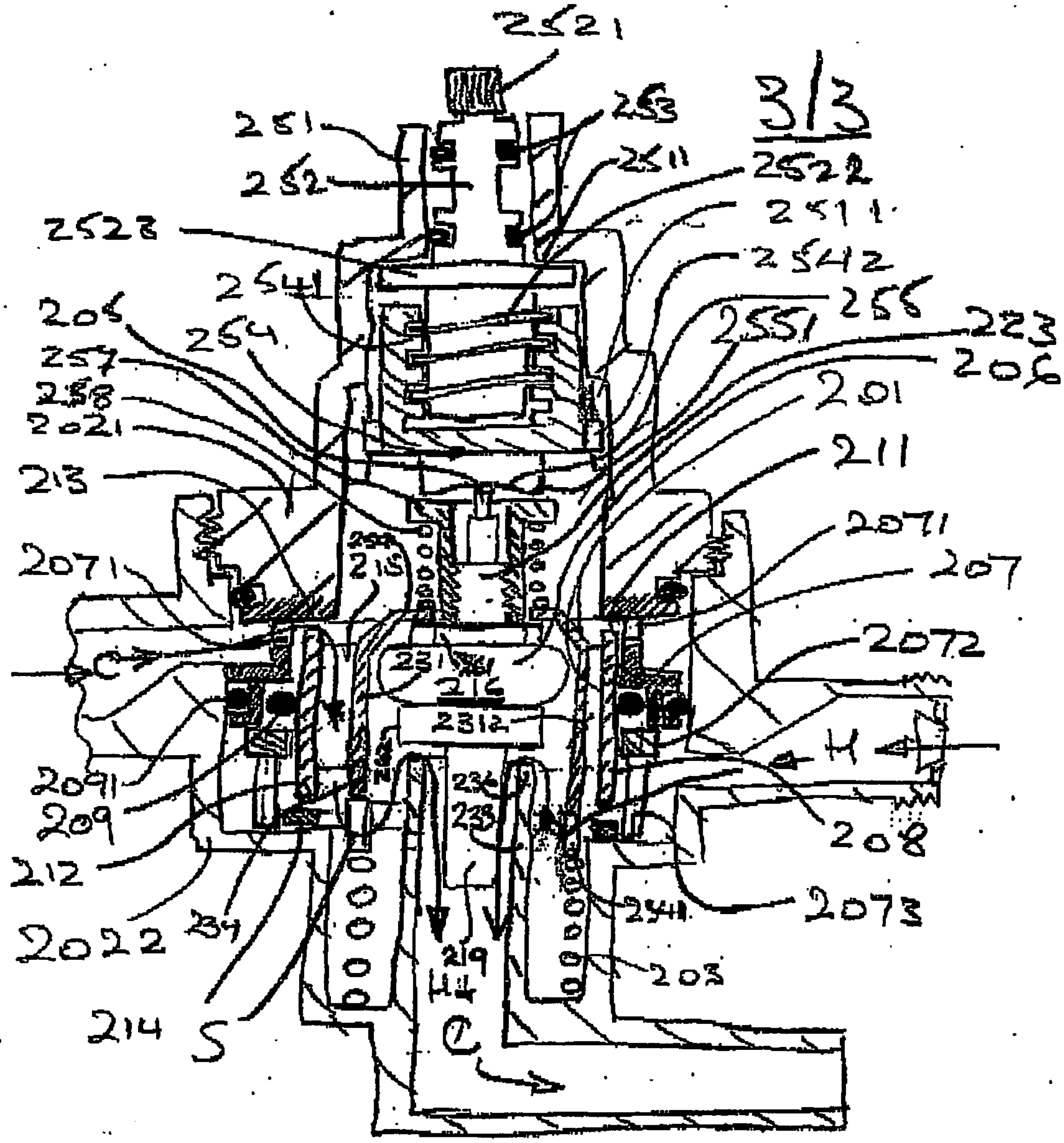
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FIGURE 3.